Sense and Respond Logistics:
Co-Evolution of an Adaptive Enterprise Capability

OFT S&R Overview Briefing (including animation)

Transforming Defense

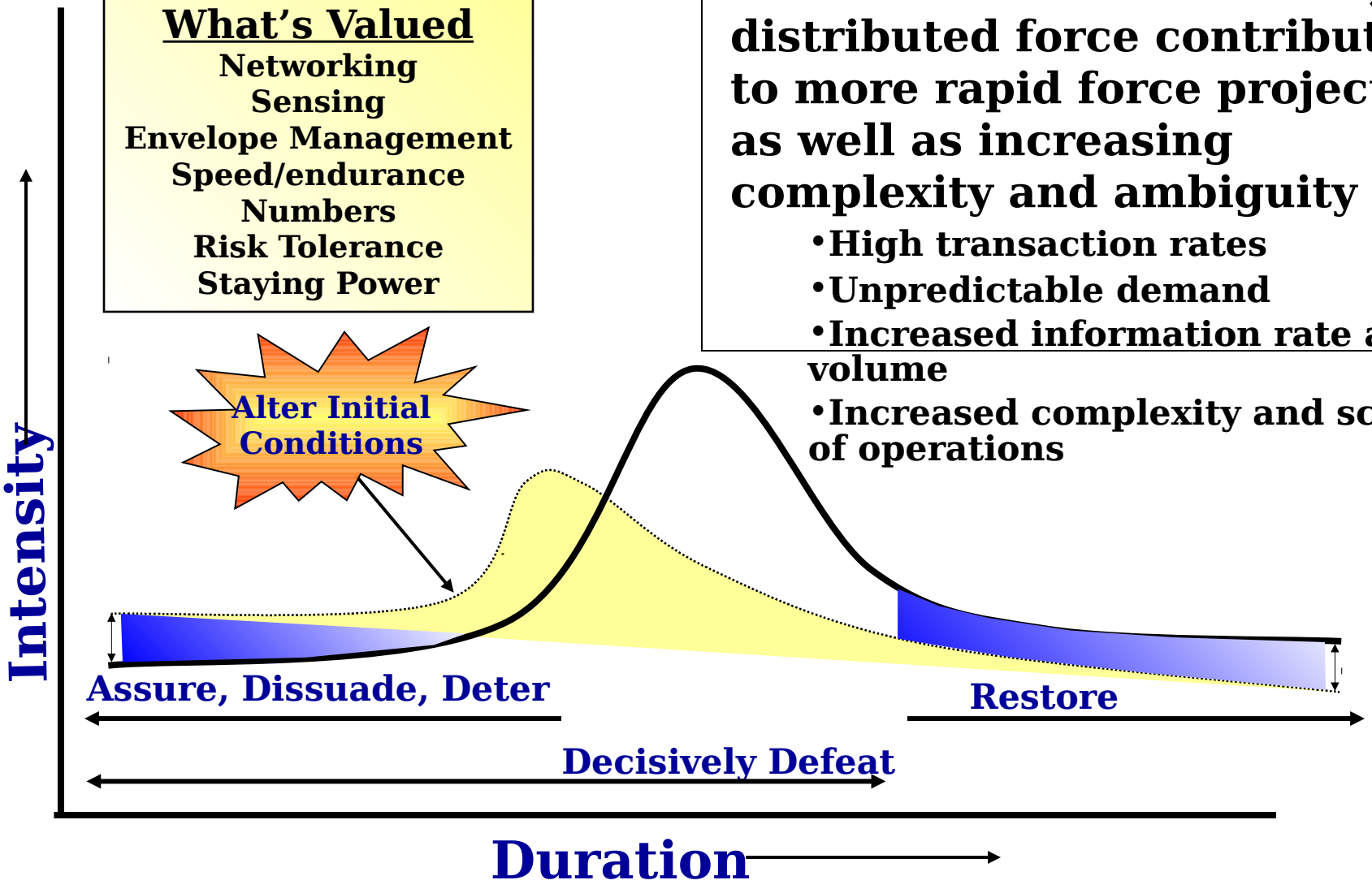
…deter forward…or defeat with modest reinforcement

Increasing the "speed of command" of a networked, distributed force contributes to more rapid force projection as well as increasing complexity and ambiguity

- **High transaction rates**
- **Unpredictable demand**
- **Increased information rate and volume**
- **Increased complexity and scale of operations**

What's Valued

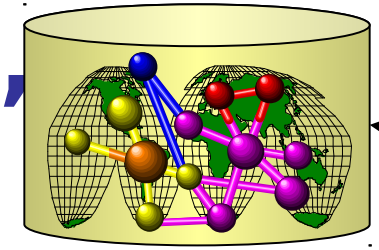
Networking
Sensing
Envelope Management
Speed/endurance
Numbers
Risk Tolerance
Staying Power



JOpsC

7 Attributes Of The Future Joint Force

Knowledge-enabled, demand driven



GIG

Critical asset visibility

Interoperable joint communications to the tactical level

S&R knowledge-based environment

Rapid configuration, re-configuration, and delivery of mission-ready capabilities

Dynamically managed inventory of capabilities

Cross-service, cross-organizational

Uses transparency, transportation flexibility and robust IT to leverage uncertainty and manage risk

Prime metric: Speed/quality of effects

Strategic Planning Guidance

Distributed, Adaptive Logistics Capability

"By 30 September 2004, USD (AT&L) will reconcile the 'Sense and Respond Logistics' (S&RL) concept, Force-Centric Logistics Enterprise, and Focused Logistics into a coherent logistics transformation strategy. In addition, USD (AT&L), in coordination with CJCS, Commander USJFCOM and Commander USTRANSCOM, will initiate a joint effort to integrate logistics from point-of-effect to source of supply/services, across Services and Defense Agencies. In addition, the next iteration of Joint and Service Transformation Roadmaps will include plans to evolve to this integrated logistics transformation strategy and address concept, process, metrics and experimentation."

OFT Strategic Appraisal

- Sense & Respond Logistics
  - ⇒ Knowledge-based, demand driven
  - ⇒ Point-of-effect through source of support
  - ⇒ “Big bet” to transform warfighting capability

- Broad conclusions: three themes
  - ⇒ Extend “jointness” through the tactical level
  - ⇒ Increase upstream prototyping and experimentation
  - ⇒ Broaden knowledge/capabilities base within DoD
    - Emerging disciplines
    - Changing skill sets
    - Industrial and knowledge base implications

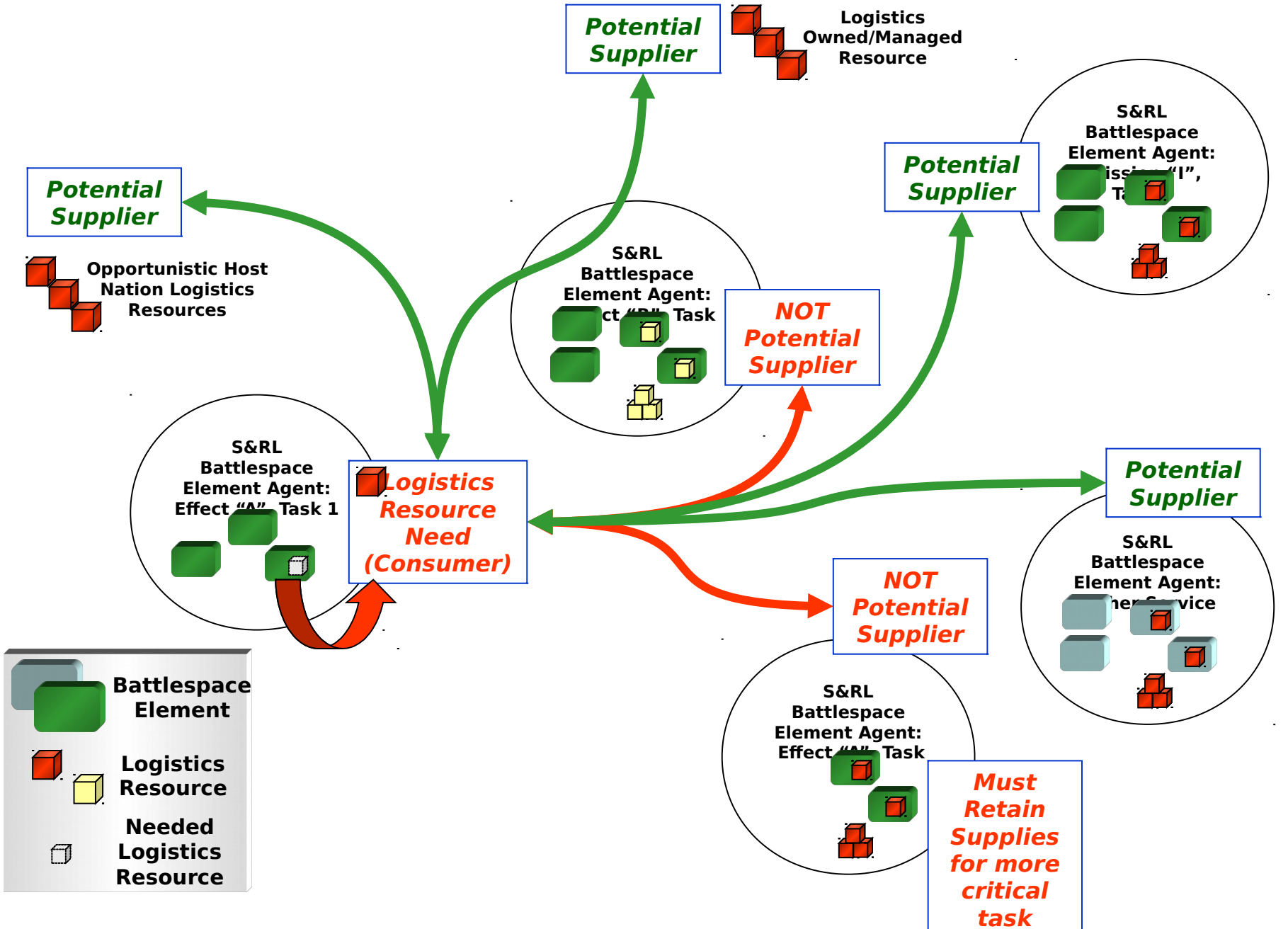
Strategy for an Accelerated Approach to CoEvolve New Capabilities

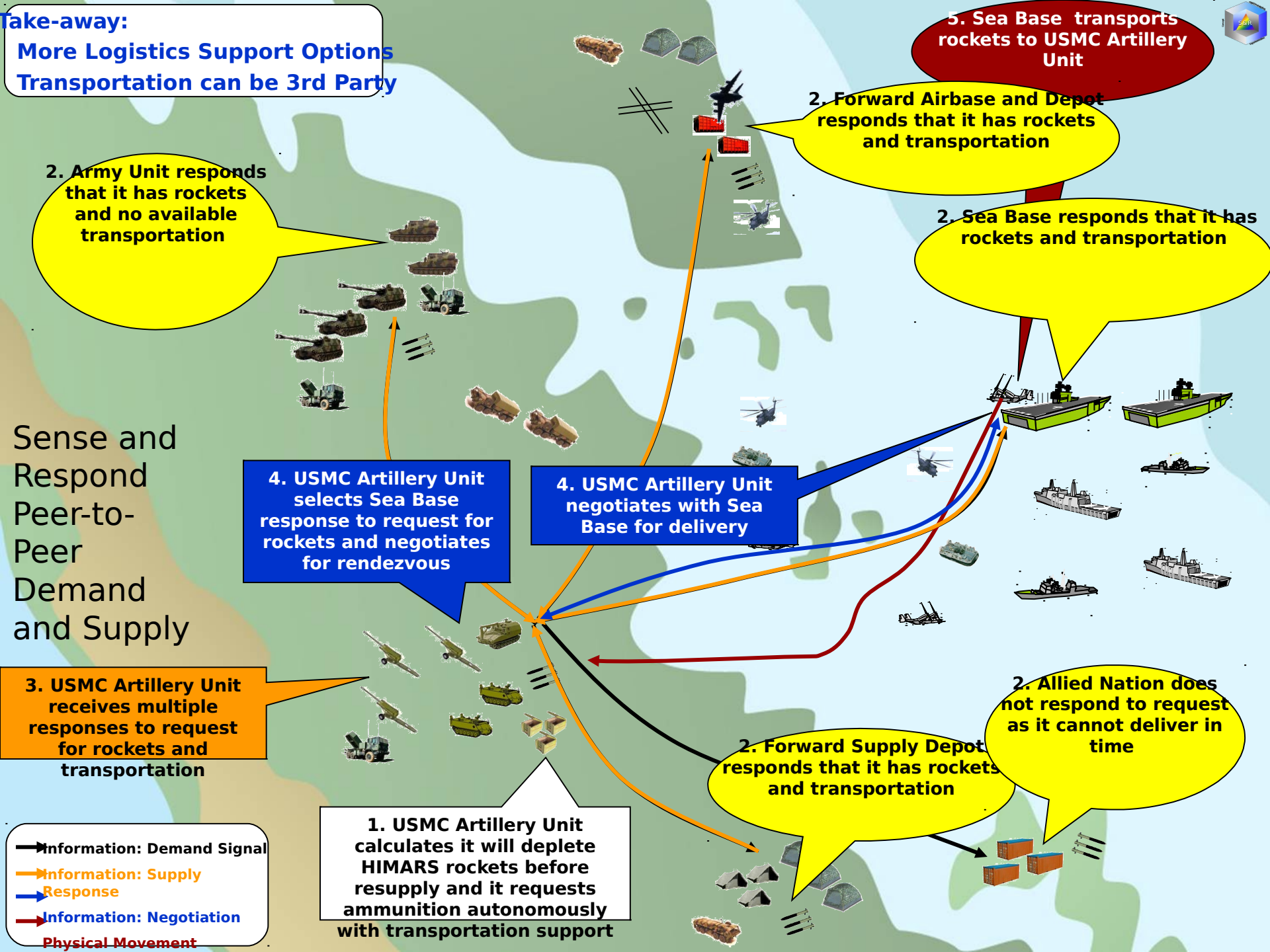
- Start with what exists today and rapidly evolve (not build up front) a capability that supports a coherently joint, adaptive style of warfighting
  - ⇒ Requires convergence into one concept
  - ⇒ Re-evaluate metrics
  - ⇒ Adopt a capabilities-based approach
- Build and experiment with a small-scale, modular, concept-driven system
  - ⇒ Inject into the operational environment
  - ⇒ Explore cross-dimensional relationships/interdependencies
- Identify changes to doctrine, training, organizations, IT systems, etc.

Shift to capabilities-based system requires rapid prototyping and experimentation from the "point of effect" back

S&RL in an Operational Context

S&RL: Networked, Adaptive Support for the Warfighter




Take-away:
More Logistics Support Options
Transportation can be 3rd Party
5. Sea Base transports rockets to USMC Artillery Unit
2. Forward Airbase and Depot responds that it has rockets and transportation
2. Army Unit responds that it has rockets and no available transportation
2. Sea Base responds that it has rockets and transportation
Sense and Respond Peer-to-Peer Demand and Supply
4. USMC Artillery Unit selects Sea Base response to request for rockets and negotiates for rendezvous
4. USMC Artillery Unit negotiates with Sea Base for delivery
3. USMC Artillery Unit receives multiple responses to request for rockets and transportation
2. Allied Nation does not respond to request as it cannot deliver in time
2. Forward Supply Depot responds that it has rockets and transportation
1. USMC Artillery Unit calculates it will deplete HIMARS rockets before resupply and it requests ammunition autonomously with transportation support
Information: Demand Signal
Information: Supply Response
Information: Negotiation
Physical Movement

How S&RL Adapts its Operations to Evolving Situation and Commander's Intent

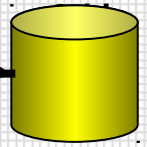
Take-away:
- **Log network adapts to evolving situation, command intent**
- **Logistics directly supports commander's intent**

Intelligence reveals that the enemy is planning a northern counteroffensive within 24 hours

New Commander's Intent, refocuses orders and associated tasks to deter the counteroffensive

POST

Global Information



Commander's Intent, Orders, and Tasks

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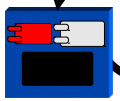

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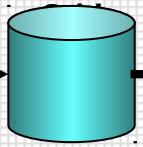

S&RL Business Rules

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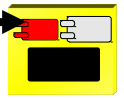
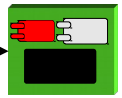
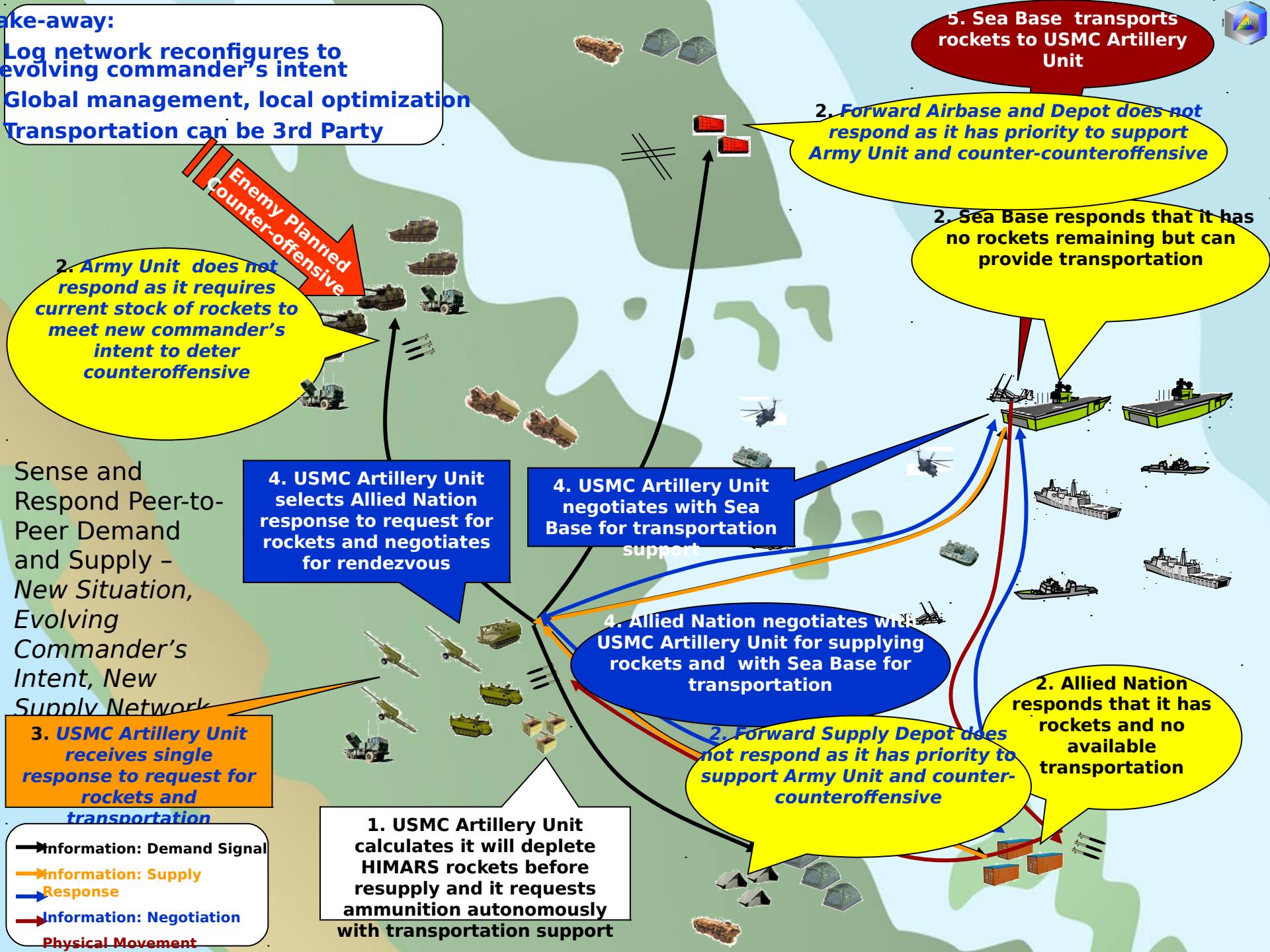
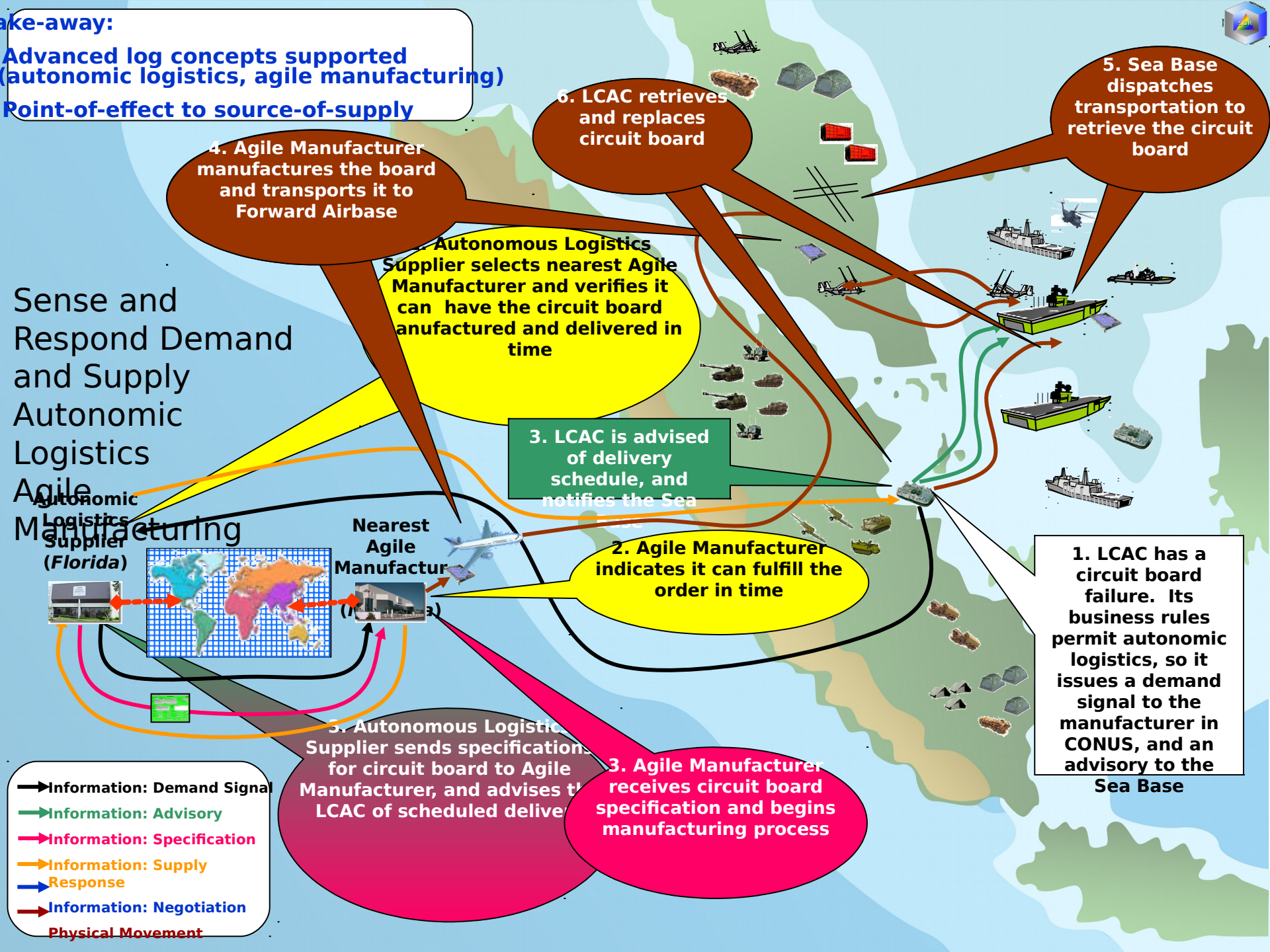




S&RL Agents, in coordination with logisticians, use common COAs, prediction, and risk assessment to update Business Rules to reflect the change in

S&RL Battlespace Element Agents automatically accept the updated Business Rules


ake-away:
Log network reconfigures to evolving commander's intent
Global management, local optimization
Transportation can be 3rd Party
Enemy Planned Counter-offensive
5. Sea Base transports rockets to USMC Artillery Unit
2. Forward Airbase and Depot does not respond as it has priority to support Army Unit and counter-counteroffensive
2. Sea Base responds that it has no rockets remaining but can provide transportation
2. Army Unit does not respond as it requires current stock of rockets to meet new commander's intent to deter counteroffensive
Sense and Respond Peer-to-Peer Demand and Supply – New Situation, Evolving Commander's Intent, New Supply Network
4. USMC Artillery Unit selects Allied Nation response to request for rockets and negotiates for rendezvous
4. USMC Artillery Unit negotiates with Sea Base for transportation support
4. Allied Nation negotiates with USMC Artillery Unit for supplying rockets and with Sea Base for transportation
3. USMC Artillery Unit receives single response to request for rockets and transportation
2. Forward Supply Depot does not respond as it has priority to support Army Unit and counter-counteroffensive
2. Allied Nation responds that it has rockets and no available transportation
1. USMC Artillery Unit calculates it will deplete HIMARS rockets before resupply and it requests ammunition autonomously with transportation support
Information: Demand Signal
Information: Supply Response
Information: Negotiation
Physical Movement


ake-away:
Advanced log concepts supported (autonomic logistics, agile manufacturing)
Point-of-effect to source-of-supply
6. LCAC retrieves and replaces circuit board
5. Sea Base dispatches transportation to retrieve the circuit board
4. Agile Manufacturer manufactures the board and transports it to Forward Airbase
Sense and Respond Demand and Supply Autonomic Logistics Agile Manufacturing
Autonomic Logistics Supplier (Florida)
Nearest Agile Manufactur
3. LCAC is advised of delivery schedule, and notifies the Sea
2. Agile Manufacturer indicates it can fulfill the order in time
1. LCAC has a circuit board failure. Its business rules permit autonomic logistics, so it issues a demand signal to the manufacturer in CONUS, and an advisory to the Sea Base
3. Agile Manufacturer receives circuit board specification and begins manufacturing process
Information: Demand Signal
Information: Advisory
Information: Specification
Information: Supply Response
Information: Negotiation
Physical Movement

Top-level Technical Overview of S&RL Functions, Architecture, and Components

What Exactly Comprises Sense and Respond Logistics

LOGISTICS KNOWLEDGE BASE

Logistics Knowledge Base:

- correlates logistics resources (supplies, services, equipment, transportation, facilities) to logistics operations for full spectrum assets visibility
- captures feedback, lessons learned, experience
- use to store knowledge created by cognitive decision aids, including

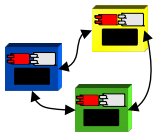
ADAPTABLE BUSINESS AND DECISION RULES

Business and Decision Rules:

- precisely tailor logistics execution (*local optimization*)
- are dynamically adapted to meet evolving commander's intent, strategic, operational, and tactical situation, battlespace environment (*global awareness*)

network-centric warfare national information infrastructure

INTELLIGENT SOFTWARE AGENTS



Intelligent Software Agents represent:

- logistics consumers
- logistics suppliers
- logistics resources

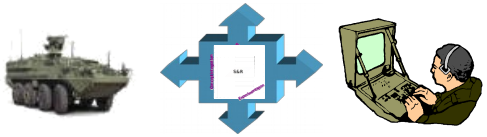
Agents also monitor:

- evolving commander's intent
- the strategic, operational, and tactical situation
- the battlespace environment
- status of friendly forces and equipment

Other Agents:

- represent the priorities for commander's intent at all levels, including effects, missions, and tasks
- control the distribution of scarce resources

LOGISTICS APPLICATIONS, PORTALS, AND INTERFACES



Logistics Applications:

- S&RL developed, and obtained from other logistics systems developments
- provide functionality to support S&RL processes

Logistics Portals:

- provide operator interface to S&RL functions
- Web-based, and graphics user interfaces
- adjusted to role, scope of operator/user

Logistics Interfaces:

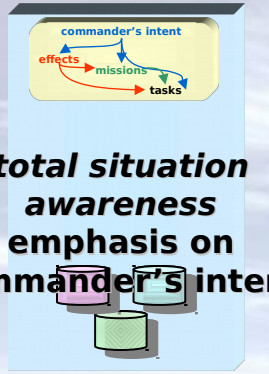
- interface S&RL functions, information, agents with other DoD, sustaining base logistics systems and data
- two-way interface
- includes interfaces to NCW infrastructure

COGNITIVE DECISION SUPPORT AIDS

Cognitive Decision Support Aids:

- analyze feedback, experience, lessons learned from the Intelligent Software agents, and adapt logistics execution and planning
- adapt S&RL execution to evolving commander's intent, situation, and environment
- support course of action analysis for logistics planning
- provide recommendations for operations and intelligence missions and tasks relative to reducing risk to achieve commander's intent due to logistics
- identify patterns of activity that require adjustment of logistics execution or planning (anticipation and prediction)
- identify and process supply network

Sense and Respond Logistics
OV-1 Top Level Concept



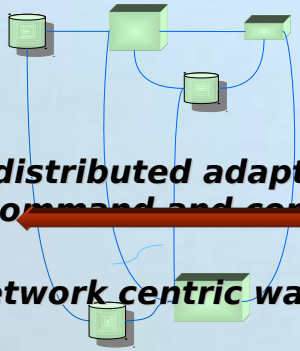
total situation awareness
emphasis on commander's intent

OPS ⟷ INTEL

force capabilities management:
logistics fully integrated with operations and intelligence

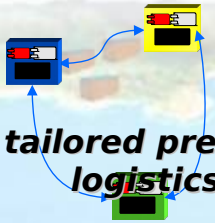
LOG

full spectrum asset visibility



distributed adaptive command and control

network centric warfare

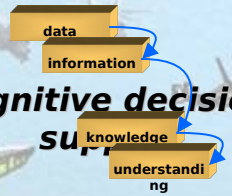


tailored precise logistics

(reactive)
SPEED

speed vs. mass
effectiveness vs. efficiency

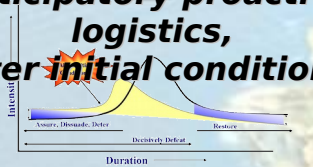
(proactive)
EFFECTIVENESS



cognitive decision sup

kinetic and potential logistics
across range of military operations

anticipatory proactive logistics,
alter initial conditions



S&RL operational capabilities

Technical Details: Analysis of Logistics Operations in an Adaptive Operational Context

Tactical Envelope and Rendezvous Integration of Operations, Logistics, and Intelligence

Example of Operational Criteria for Sense and Respond Transactions

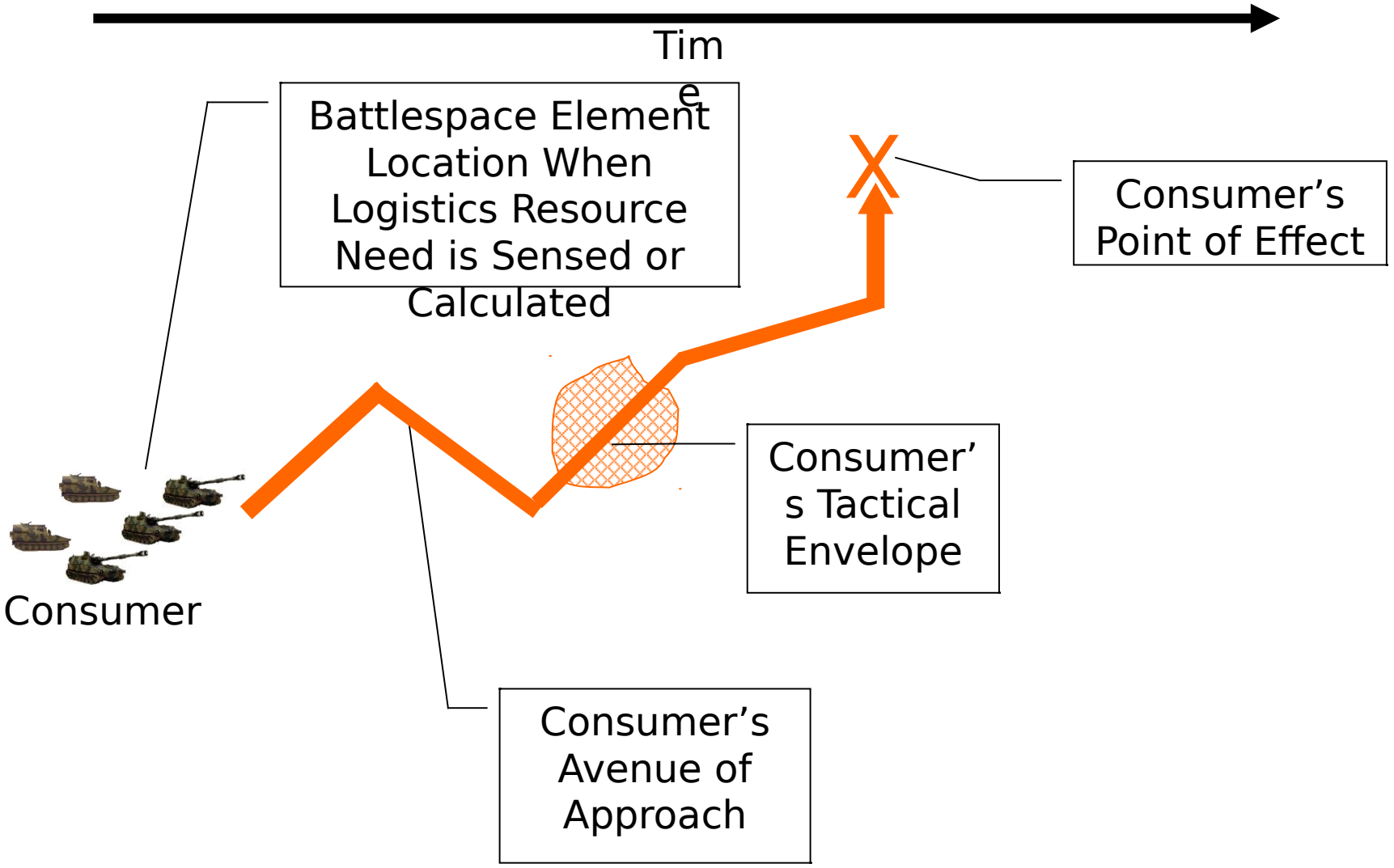
Tactical Envelope and Rendezvous Calculation:
Can it be done?

- Time
- Distance
- Volume of Sustainment (Scale)
- Range of Sustainment (Momentum)
- Transportation availability, volume, rate of loading/unloading, rendezvous options
- Required Support (Service to install/repair/load/unload)
- Information and Knowledge Required
- Probability of Success

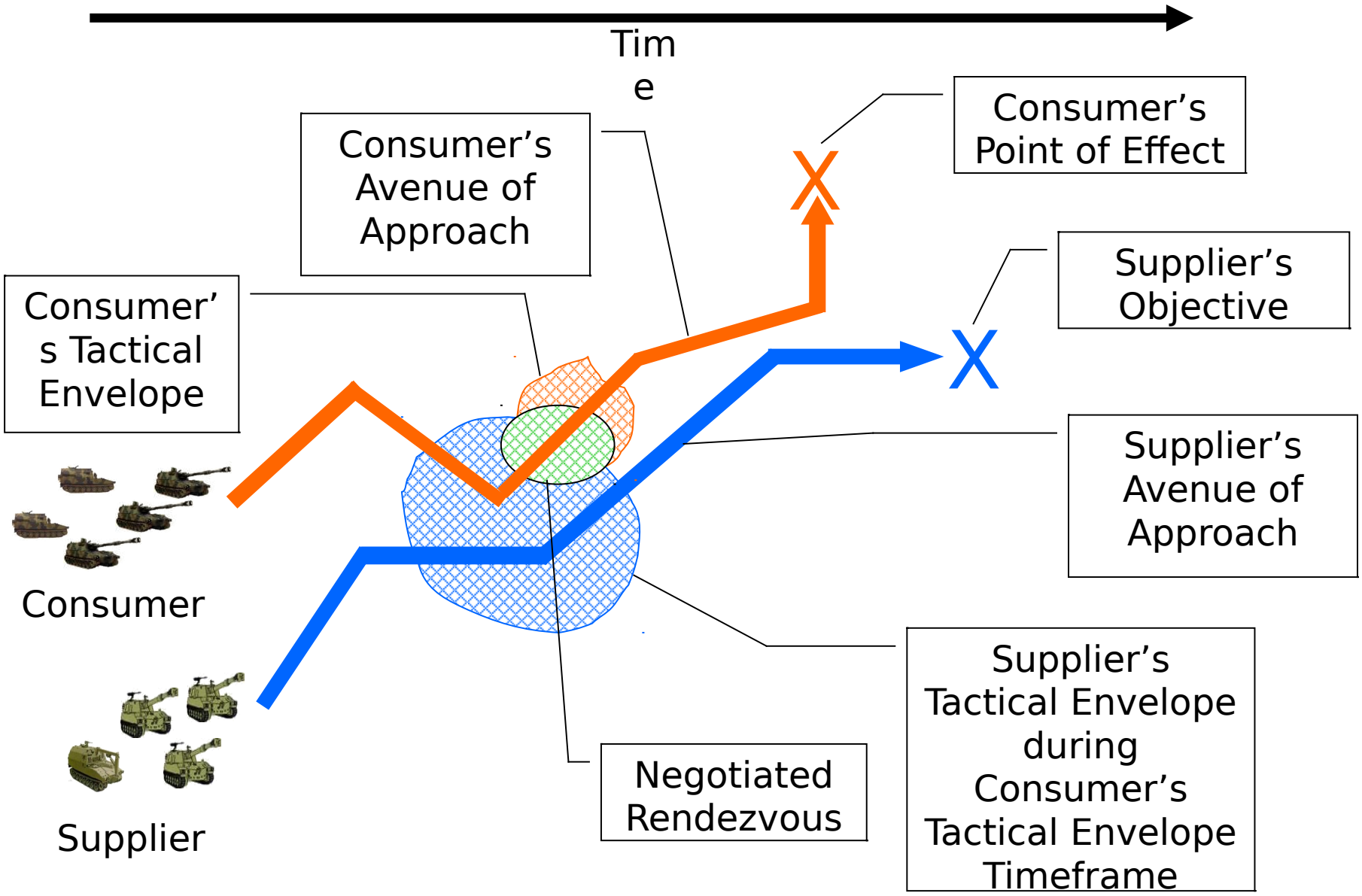
Strategic, Operational, Tactical Calculation:
Should it be done?

- Effect (s) (Commander's Intent/End-state)
- Influence on the Force and on Combat Power Ratio
- Alternative Support Analysis and Risk Reduction/Mitigation
- Options (fire, maneuver, communication)
- Rate of Distribution [f(x) D/RT (M/F * Commander’s Intent)]
- Level of Coherence
- Cost ($)
- Impact on Morale
- Probability of Victory
- Benefits - other
- Transition ability

Consumer Tactical Envelope Calculation

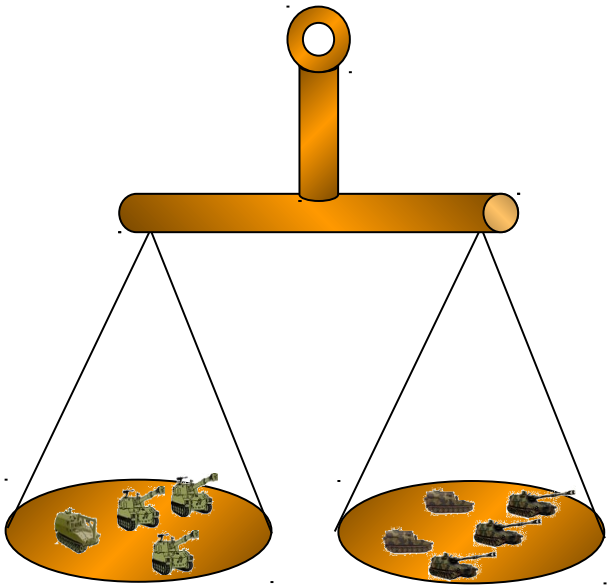

Time
Battlespace Element Location When Logistics Resource Need is Sensed or Calculated
Consumer's Point of Effect
Consumer's Tactical Envelope
Consumer
Consumer's Avenue of Approach

Supplier Tactical Envelope and Rendezvous Calculation



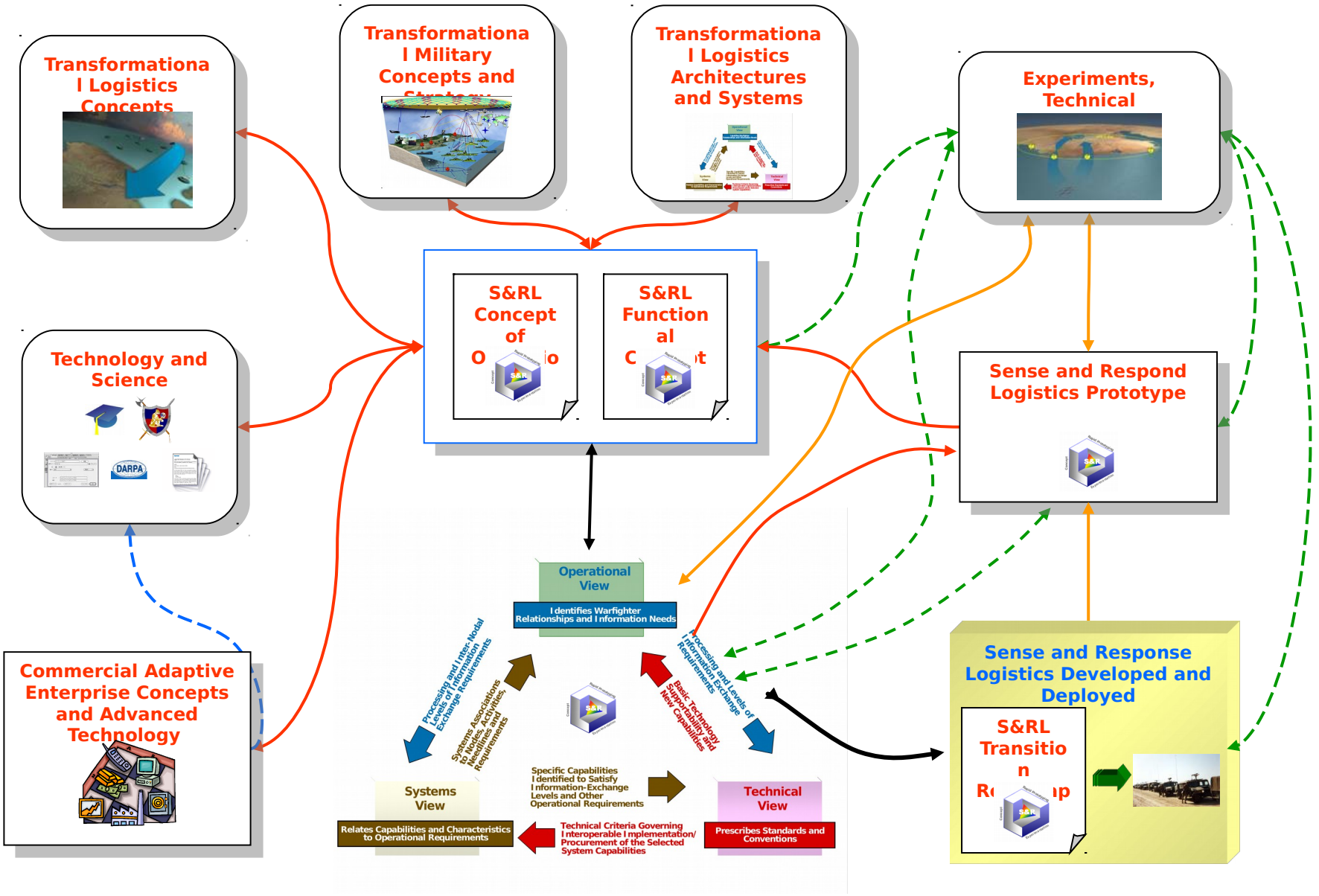
Operational Value Assessment

- Operational Value is an assessment of the priority of some task, mission, or effect relative to other tasks, missions, and effects, either:
  - ⇒ In an operational area within a battlespace
  - ⇒ Within some timeframe across an operation
  - ⇒ Relative to risk assessment against meeting strategic, operational, or tactical parameters of commander's intent
  - ⇒ Relative to risk assessments of the situation, including such elements as weather, and
  - ⇒ Combinations of the above
- Operational Value must be calculated to support decisions for requesting needs or meeting demands when a logistics resource is in limited supply
- Operational Value is normally calculated by a "Broker", but may be used by a potential supplier to determine if the requested logistics resource is critical to the supplier's task, mission, or effect

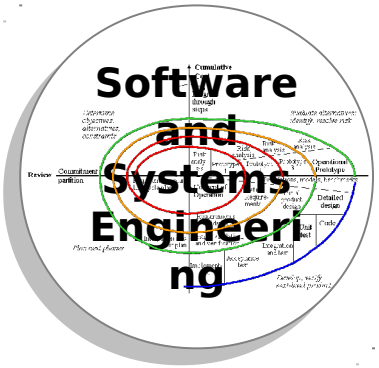


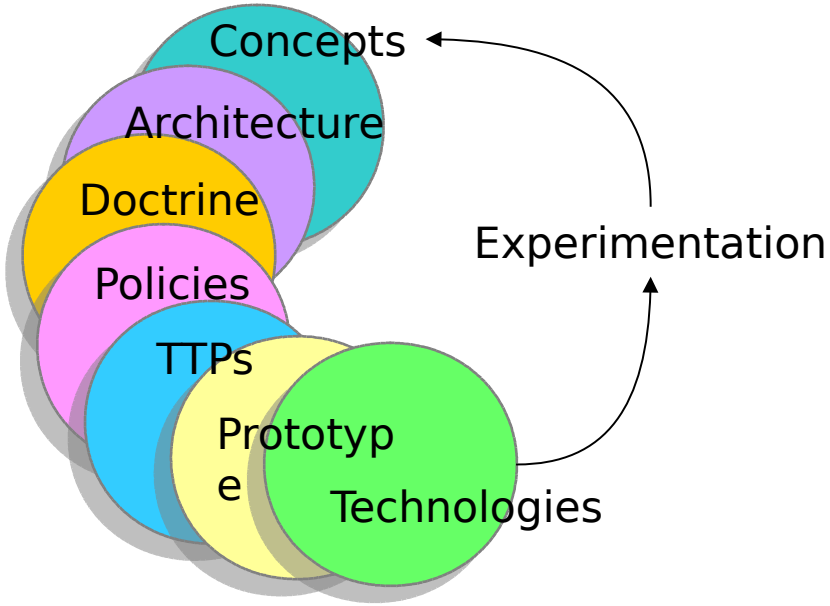
The Co-Evolution Process and Experimentation Campaign

Co-Evolution of Sense and Respond Logistics


Transformational Logistics Concepts
Transformational Military Concepts and
Transformational Logistics Architectures and Systems
Experiments, Technical
S&RL Concept of O
S&RL Functional C
Technology and Science
DARPA
Sense and Respond Logistics Prototype
Commercial Adaptive Enterprise Concepts and Advanced Technology
Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Inter-Nodal Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines and Requirements
Basic Technology Support Capability and New Capabilities
Processing and Levels of Information Exchange Requirements
Sense and Response Logistics Developed and Deployed
S&RL Transition
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities
Technical View
Prescribes Standards and Conventions

Spiral Development ≠ Coevolution





Spiral Development Model

1. Focuses on software and systems development and engineering processes characterized by cyclic engineering and segments

2. Concurrency through separate coordinated spirals

3. Can be evolutionary, but increases development complexity

4. Emphasis hardware, software development

5. Cycles driven by risk considerations

Coevolution Strategy

1. Focuses on continuous implementation of concepts, architectures, policies, technologies, doctrine, TTPs, and prototype, characterized by continuous assessment and feedback from the bottom up

2. Concurrency through coevolutionary coordinated development of concept, prototype, architecture, and technology

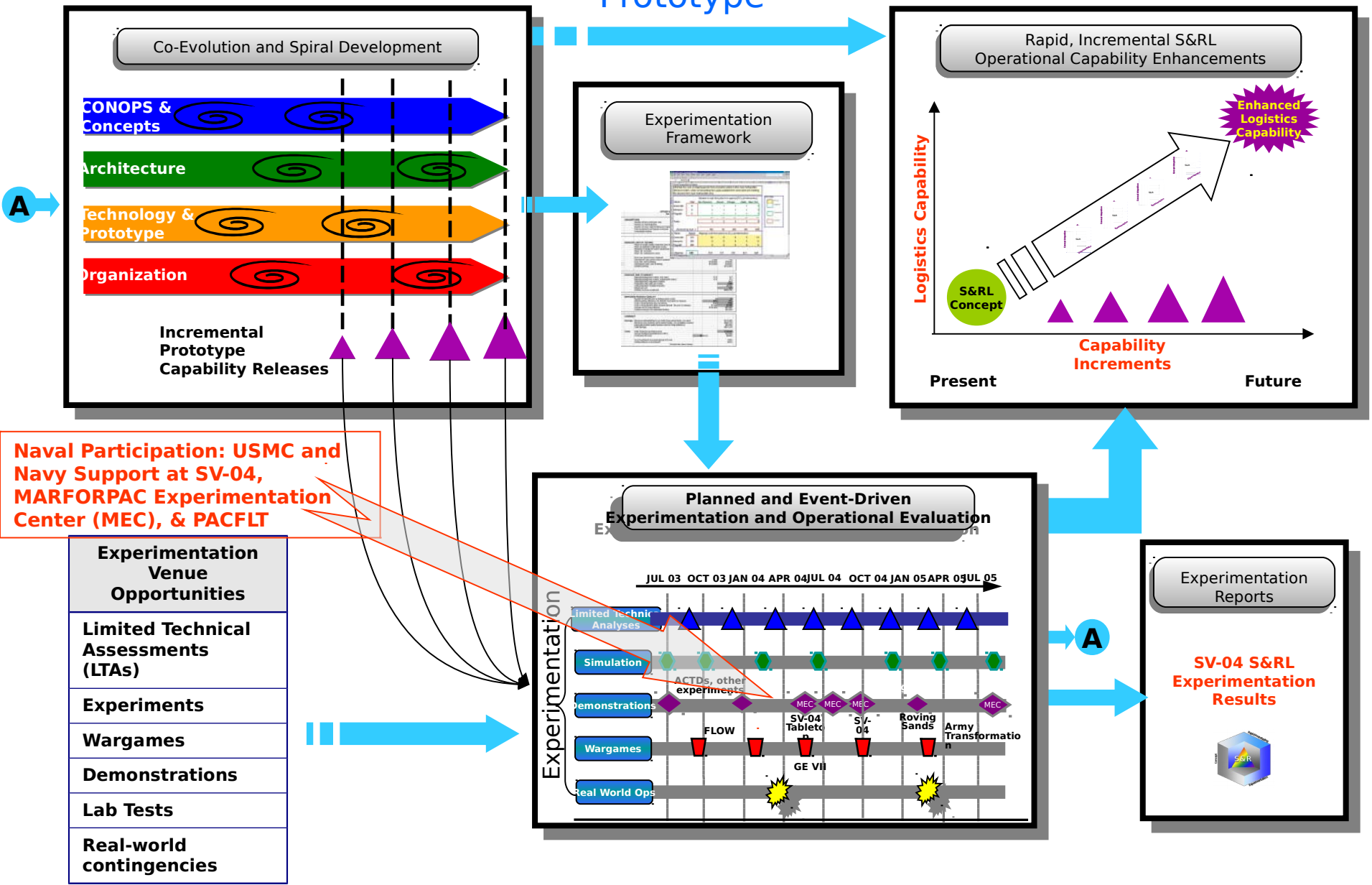
3. Evolution is inherent

4. Emphasis on warfighter benefit

5. Cycles driven by design experiments

S&RL Experimentation Campaign Plan Objectives:

- Obtain Warfighter's Review, Perspective, and Inputs
- Coalesce, Validate, Improve the Concept, Architecture, Prototype



Experimentation Venue Opportunities
Limited Technical Assessments (LTAs)
Experiments
Wargames
Demonstrations
Lab Tests
Real-world contingencies

Creating Change: The IT Prototype and Experimentation

- Consists of an Integration framework and applications
- Uses a network-centric, real-time platform based upon open standards, COTS/GOTS, intelligent agents, and decision rules
- Consistent with NII architecture
- Supports expansion from single Service to Joint to enterprise experimentation to include not only logistics but also Ops, Intel (ISR), and C2
- Currently leveraging IT prototype to support concept development, experimentation, learning, and discovery
- Promotes doctrinal and organizational change

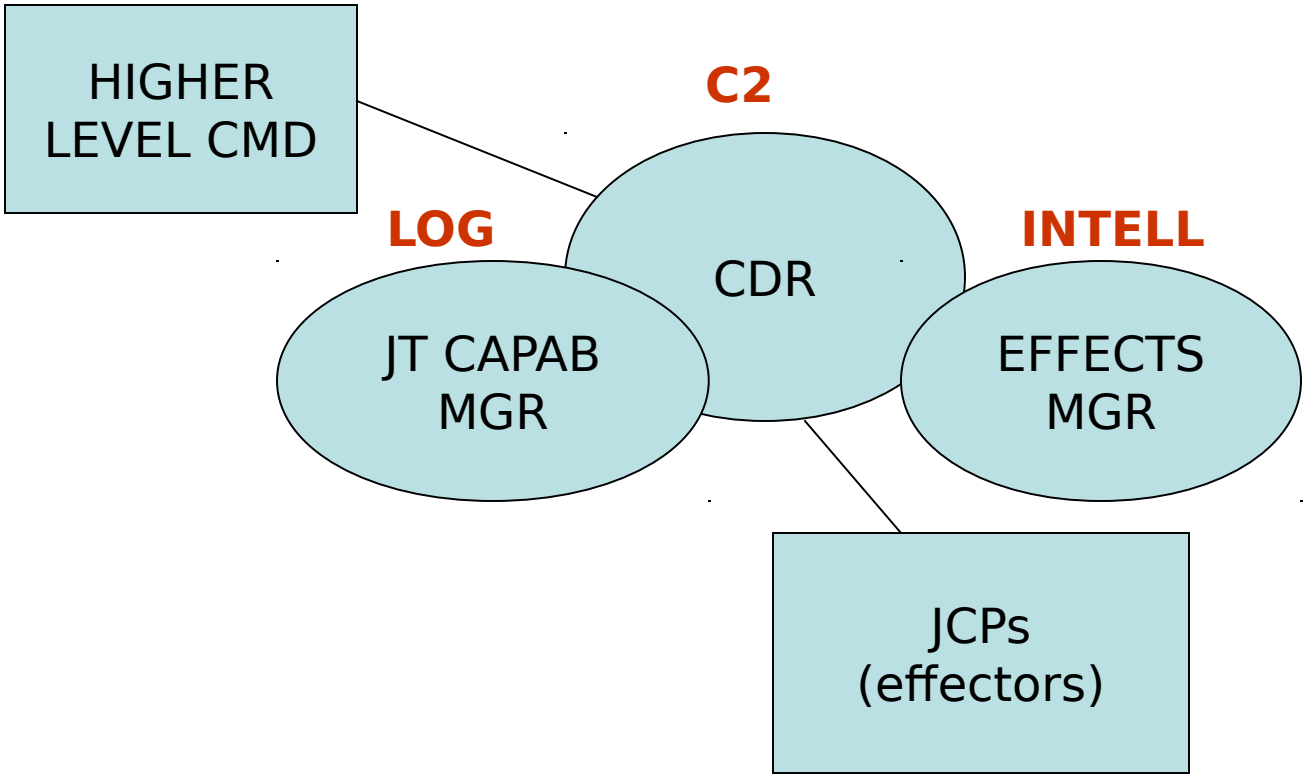
ms how to bridge the gap between today's capab
and a future knowledge-based system

The IT Prototype and the USMC

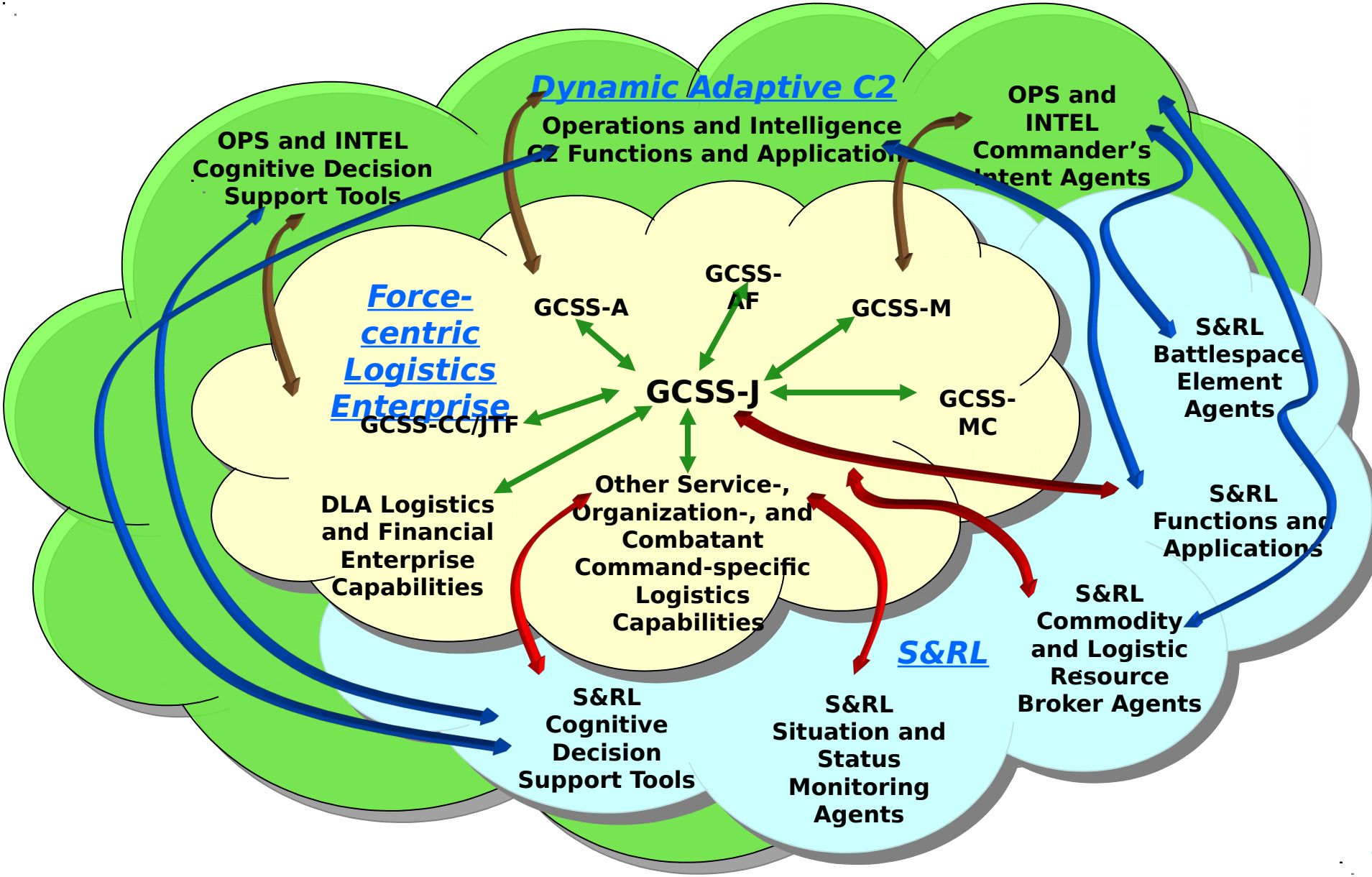
- Links the S&RL concept to the IT Prototype
- Demonstrates exploration from simple to complex (i.e. beyond current view of MAGTF operations into more complex, joint, distributed expeditionary warfare)
- Leveraged as a device to interact with the USMC participants to draw out decision rules and lessons learned
- Defines the relationship of S&RL to other Joint and USMC logistics and C4ISR components
- Tests hypotheses dynamically and demonstrates the range of behaviors possible in an S&RL system
- Rapidly moving from simple and complex logistics agent operations to cognitive decision support and integration with OPS, INTEL, and C2
- Informs how to bridge the gap between today's capabilities and a future S&R capability

The Adaptive Organizational Design

Exploring new role
and accountability designs
in a networked system



Under the Hood of Joint Adaptive C2



Proposed Way Ahead to Converge S&RL and USMC Logistics Modernization

- Leverage and instantiate the S&RL Knowledge, Insights to date, Experimentation Framework, and Learning Prototype built in partnership with the USMC to rapidly enhance USMC capabilities
- This direction is consistent with DoD strategic and policy guidance on Transformation and consistent with the USMC Logistics Modernization Program
- Use S&RL and co-evolution strategy and techniques to build upon and extend the USMC Log OA and GCSS-MC to accelerate progress towards an adaptive enterprise capability
- It's bigger than Log--Extend the S&R warfighting philosophy and practices to C2, Operational, and Intelligence Domains and build a collaborative, adaptive, distributed force and support capability
- Identify linkages and specific leverage points in USMC programs and initiatives which can benefit from S&R in these areas:
  - ⇒ Concept
  - ⇒ Process
  - ⇒ Metrics
  - ⇒ Experimentation
  - ⇒ Policy

Integrating S&RL and Extending GCSS-MC

- The S&R philosophy, concept, and architecture espouses a transformational, warfighter-oriented, integrated OPS/INTEL/LOG approach relying on NCW, and the Log OA and GCSS-MC are derived from current USMC needs, employing commercial and service best practices within relatively fixed organizational structures
- As an intermediate step to then experiment with, the forward edge, peer-to-peer and autonomous logistics support, adaptability, knowledge exploitation, and NCW integration provided by S&RL can be integrated with GCSS-MC business and supplier relationship/ERP processes through data exchanges and transactions
- Existing/planned GCSS-MC capabilities can be combined and enhanced with S&RL agents, cognitive decision aids, knowledge bases, and other S&RL interfaces, applications, and portals to provide a transitional capability that refocuses and potentially accelerates the progress towards NCW, OPS/INTEL/LOG integration, and adaptation from point-of-effect to source-of-supply
- Propose experiments integrating S&RL with GCSS-MC to identify:
  - ⇒ opportunities for integration and coordination, and for inclusion of adaptive logistics in USMC operations
  - ⇒ alternative adaptable organizational structures, doctrine, and TTPs that transform logistics and integrate it with OPS and INTEL capabilities in an NCW framework
  - ⇒ metrics extensions that refocus logistics operations to capabilities-based support
  - ⇒ establishing a path for integration of S&RL with other service, joint, and combatant command logistics, operations, and intelligence systems and capabilities (a transition roadmap element)

Way Ahead
… top down and across

- Establish a wider partnership for SPG execution (AT&L, JS J4, JFCOM, USTC, PACOM, OFT, Services)
- Extend technical exchange across partners to expose S&R theories, principles, and experimentation methodology and design
- Develop a convergent concept for FL/FLE/ S&RL/JDES tied directly to the JOpsC
- Create rapid pathways into concepts, programs, and practice
- Develop and imbed cross-enterprise mechanism for sustaining innovation

Way Ahead
...pointy end back

- Leverage PACOM as an experimentation venue
  - ⇒ Link operational piece to S&R experimentation platform
- Form focus group of selected warfighter organizations to define the best way to evaluate/implement S&R
  - ⇒ Meet in Mar 2004 with participation of I MEF, III MEF, 3d FSSG, and 3d MARDiv
  - ⇒ Define test objectives
    - Produce test and assessment plans
    - Identify appropriate units for participation
  - ⇒ Choose selected experimental venues for progressive evaluation
    - Limited Objective Experiment – Jul 04
    - HCAX – Jan 05
    - COBRA GOLD – Mar 05
  - ⇒ Continue prototype development to incorporate warfighter recommendations
    - SV04 – Oct 04
- Create rapid pathways into concepts, programs, practice
- Develop cross-enterprise mechanism for sustaining innovation

Metrics and Scorecard Linkages

- Emphasize tactical-back approach:
  - ⇒ Primary Logistics objective: Support to joint, adaptive, distributed operations effectiveness and capabilities; Secondary objective: Efficiency, cost and footprint reductions
- Drive USMC Supply Chains directly by military operational demand signals and increase supplier visibility of operational drivers to increase effectiveness and reduce risk and uncertainty
- The Log OA is based heavily on the Balanced Scorecard and the SCOR model
- Like the DoD Logistics Balanced Scorecard, the Log OA should be analyzed and changes recommended to drive Logistics system behavior and design
  - ⇒ Design the Balanced Scorecard to be linked to, and driven by, operational strategy and concepts (an NCW-based Strategy Map)
  - ⇒ Develop a more comprehensive set of effects-based, operational metrics and build them into the customer block of the Balanced Scorecard
- Define the ultimate customer as the enemy (or friend) and the operator as the customer to help sharpen the customer end of the SCOR model
- Review current OA and GCSS-MC initiatives for opportunities to explicitly link incentives to operational effectiveness as the first priority

Process Linkages

- Map the S&RL architecture, process model, and roles directly to the USMC Log OA process model and roles
- Use the Learning Prototype to experiment and evaluate baseline OA concepts, processes, and roles and alternative S&RL concepts, processes, and roles
- Expand the OA model to be end-to-end, not just across the Logistics Chain, but from *point-of-effect* to source of supply/service and focus on jointness through tactical back
- Extend the process model to explicitly include Force Projection and Sustainment

Experimentation Linkages

- Leverage the S&RL Experimentation Framework and Learning Prototype to develop a comprehensive USMC Experimentation Plan across all venues to accelerate progress towards S&R capabilities
- Test mechanisms for giving visibility of operational information and decisions to all support nodes and roles including populating the nodes and roles with USMC subject matter experts and also interacting with weapon system managers, commodity managers, and vendors/suppliers of services
- Evaluate impact of the availability to drive support processes by high fidelity, real-time, point-of-effect and demand signals prioritized globally, captured locally, across multiple, simultaneous, distributed force operations and available throughout the enterprise to global suppliers and repairers
- Track operational metrics as well as more traditional Logistics performance metrics in real-time
- Analyze and possibly simulate gains-sharing contract models which encourage incentives tied directly to operational support performance based on negotiated Service Level Agreements (SLAs)
- Evaluate implications for structural change in acquisition, contracting, sourcing, training, education, etc. policies and processes to maximize operational capabilities

Integrating Suppliers into S&RL

- Develop methods and initiatives for involving suppliers, weapon system managers, and other end-to-end supply chain entities and leveraging their solutions, knowledge, and recommendations where appropriate
- Include support appropriate for consumable and reparable supply chains and services and for weapon systems (or major end items) which are used by multiple services and form basis for Joint Force Capability Packages
  - ⇒ Important to involve both public and private participants
  - ⇒ Important to model both supply and repair capabilities
- Use planned experiments such as SV04, the MEC, Labs, and all other venues and means and future concepts such as Joint Sea Basing Operational scenarios and planned force structure to choose suppliers and design the experiments

Examples of Linkages to Suppliers

- S&RL provides real-time visibility over past, current, and projected consumption of fuels by location for all services to DLA and to DLA's fuel suppliers on a push or pull basis
- All damage of tracks on tracked vehicles, demands, and supply position of tracks is made available to Goodyear who supplies all tracks for all vehicles to the Army
- For a supplier like Goodyear who supplies all of the goods, we would experiment with different forms of IT linkages, metrics, PB agreements, incentives driven by operational requirements, and creative contract and acquisition policies to increase operational support
- Provide a common operating picture of operational activity for specific commodities or services to suppliers that is integrated across services, geography, and operational events
- S&RL can provide anticipatory demands based upon anticipated ship operational activities to Logistics Services such as port provisioning
- Weapon systems and critical end-items with Advanced Planning and Scheduling (APS) systems receive real-time push transactions and info about op tempo to anticipate repair actions
- Demand signals can be used as induction signals to keep the repair process synchronized with operational activity
- Demonstrate how real-time changes in anticipated operational events impact required capabilities and, in turn, demands for commodities and services